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THE CHROMOSOMES OF PODOPHYLLUM PELTATUM

GABRIELE N. MÜHLING AND G. B. WILSON[1]

Podophyllum peltatum L., commonly known as May Apple, Mandrake or Pomme de Mai, represents one of the best sources of cytological material for class purposes. It is found in eastern North America, east from a line drawn from Minnesota to Texas, including southern Ontario and Quebec. Representatives of the genus also occur in eastern Asia (Fernald, 1950). Large amounts can be collected easily and the sporogenous material is normally found to be in meiosis for about a two week period. Good cytological preparations can be made by simple techniques. The early stages of meiosis especially pachytene can be fixed and stained giving a clarity that equals maize. The chromosomes are large and few in number.

The advantages of the material do not seem to be recognized very generally probably because the cytology has not been described in any detail since 1926 when Kaufmann published his general description of the karyotype and meiosis. It therefore seemed worthwhile reporting and illustrating the work from our own collections of this material.

MATERIALS AND METHODS

Flower buds of *Podophyllum peltatum* L. were collected in the Oakland and Ingham Counties of Michigan. Collections

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The authors wish to thank Mr. P. G. Coleman for his preparations of the illustrations.

of anthers from these areas have been made yearly for the past six years. The most extensive collections were made in 1954 and 1959 and the main part of the data for this paper were obtained from these. Buds from the former year were fixed in the field in 3 parts absolute ethyl alcohol and 1 part glacial acetic acid and from the latter year in a 6:3:2 mixture of absolute methanol, chloroform and propionic acid (Piennar, 1955) and then placed under vacuum as soon as possible. Microspore mother cells of anthers were prepared for analysis mostly by staining by the Feulgen technique after a 9-10 minute hydrolysis in 1 N HCl at 60° C. Each anther was carefully squashed on a slide to separate the sporogenous tissue from the tapetum. Slide preparations were dehydrated in a 9:1 mixture of tertiary butyl alcohol and absolute ethyl alcohol overnight and then mounted in diaphane. Some material was stained with aceto-carmine. Fixed anthers were macerated in 1 N HCl at 60° C for 5 minutes prior to staining. Before dehydration, excess carmine was removed from preparations by running a drop of 45% acetic acid under the cover slip. If this is not done the cytoplasm becomes dark, often obscuring the division figures.

DISCUSSION

1. *Karyotype:* Our observations of a haploid number of six chromosomes in *P. peltatum* are in agreement with those earlier reported by Litardière (1921) and Kaufmann (1926). The kinetochores are found in three positions — each type appearing twice in the karyotype. In two chromosomes the kinetochores are in a near-median position; in two, in a submedian position and in two, in a subterminal position. The relative lengths of the arms of the chromosomes measured at anaphase II in the above order are: approximately 1:1; 1:2; and 1:18. For convenience the three types shall be called A, B, and C respectively. One chromosome of each of the three types has a satellite. It appears on the long arm in types B and C (Plate 1262, fig. 7, 8 and 9). It is not possible to determine which arm contains the satellite in type A because of their near identical length and the lack of any other morphologically distinguishing characteristic

(Plate 1262, fig. 9). In some details this description of the satellites does not agree with that of Kaufmann (1926) which may be because of the difficulty in detecting them or because a different population was sampled. A number of

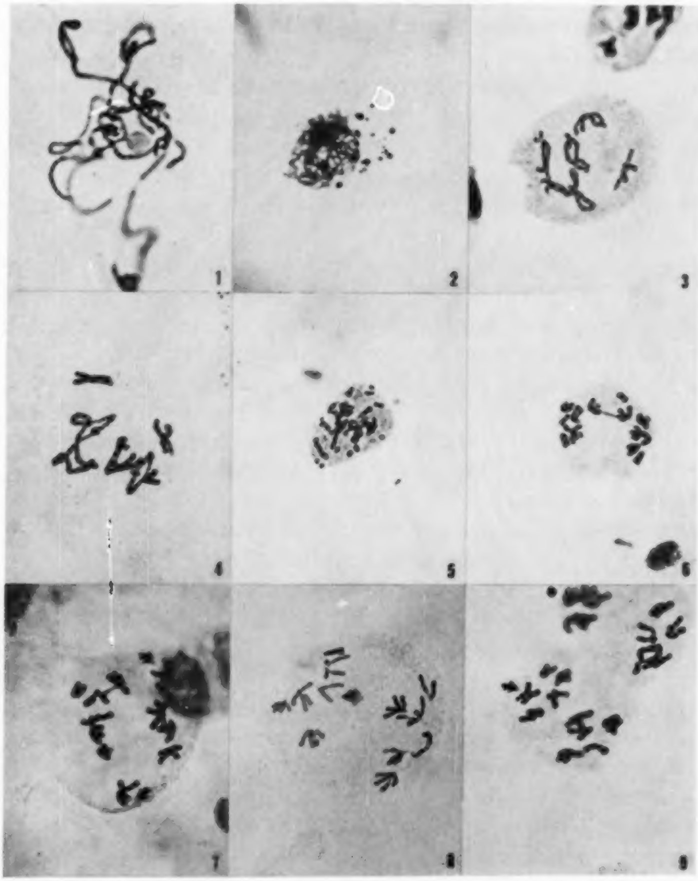

PLATE 1262. Fig. 1. Pachytene showing nucleolar attachment. Fig. 2. Zygotene with DNA blobs. Fig. 3. Diakinesis and faint outline of nucleolus. Fig. 4. Interlocking chromosomes. Fig. 5. Probably a metaphase I with numerous fragments. Fig. 6. First anaphase bridge and fragment. Fig. 7-9. Anaphase I. Arrows point to chromosomes with satellites.

peculiarities are noted in the occurrence of these satellites. First of all we did not observe them in somatic anaphases when they generally do appear in material which has them. Furthermore frequently a satellite is only visible in one chromatid of a first division anaphase chromosome, its partner having no indication of this structure whatsoever (Plate 1262, fig. 9).

The total length of the complement of six chromosomes of this species is about 60 microns. The lengths of each of the chromosomes expressed in terms of the total length of the complement is approximately as follows: the median attached chromosome, 20% ; submedian 17% ; and subterminal, 13%.

2. *General description of meiosis:* The key stages are shown in the figures in Plate 1263. They are consistent with the generalized textbook descriptions. Pachytenes are particularly good. In cells where they are sufficiently spread out, it is possible to count the number of chromomeres in a chromosome. The interkinesis between the two meiotic divisions is well marked, sometimes being so complete that nucleoli appear although this seems to be somewhat unusual. Cytokinesis does not occur until the end of second division so that diads are sometimes confused with binucleate tapetal cells since they are somewhat similar in size and shape.

A number of special features of the material deserve some comment:

a. The nucleolus: In somatic tissue the number of nucleoli appears to vary from one to three. So far we have failed to determine with which chromosomes they are associated. In meiosis there is consistently a single nucleolus, which is associated with one of the two subterminally attached chromosomes. Although the satellite can not be seen all of the time, it is assumed that the nucleolar association is with the chromosome possessing the secondary constriction. The nucleolar organizer region appears to be in the proximal third of the long arm and is not associated with any obvious secondary constriction. In any case, the three secondary constrictions noted do not seem to be concerned with nucleo-

lar formation. In some plants such as maize (McClintock, 1934) the nucleolus develops from a definite organizing region in the area of the secondary constriction.

b. Some microsporocytes that appear to be between zygotene and pachytene frequently show a large number of Feulgen positive bodies (Plate 1262, fig. 2). Similar observa-

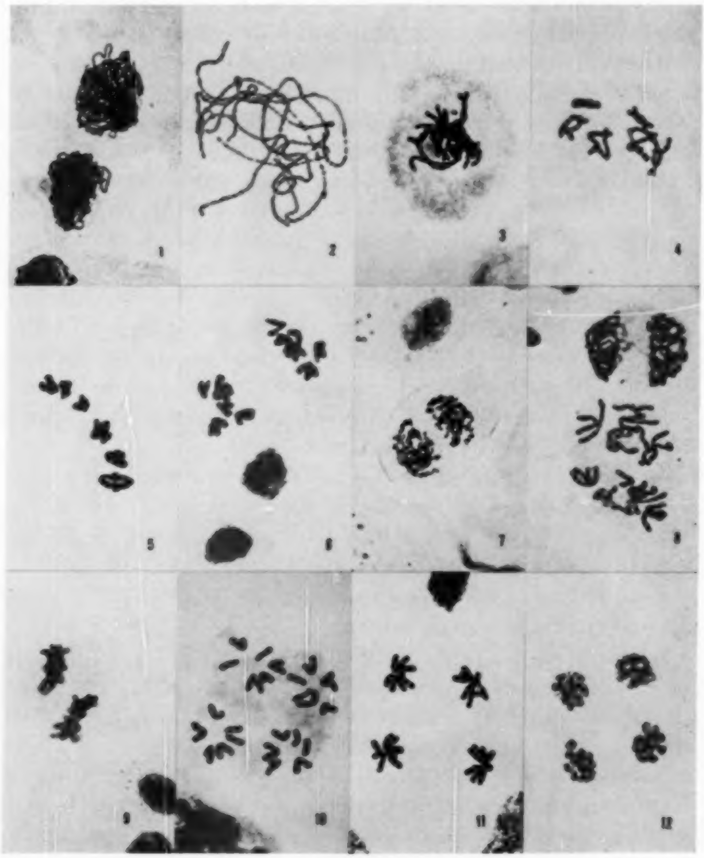

PLATE 1263. Stages of meiosis in *Podophyllum peltatum.* Fig. 1. Zygotene; 2. Pachytene; 3, Diplotene; 4, Diakinesis; 5, Metaphase I; 6, Anaphase I; 7, Telophase I; 8, Prophase II; 9, Metaphase II; 10, Anaphase II; 11, Late anaphase II; 12, Telophase II.

tions have been made in *Trillium* (Sparrow & Hammond, 1947) and *Lilium* (Cooper, 1952 and Takats, 1959). Sparrow and Hammond (1947) suggest that this represents a transfer of nuclear DNA to the cytoplasm. Similarly Cooper suggests that this represents movement of DNA from the tapetum to the locules and ultimately into the nuclei of the microsporocytes. After an extensive examination of this phenomenon, Takats (1959) concludes that there is no evidence for transfer of DNA to the microsporocytes from the tapetum during this stage in meiosis. He suggests that the extrusion may be caused by such factors as injury to the anthers at time of harvest and type of fixative used. We are inclined to take the view that they represent an abnormality of some sort and doubt that such cells proceed through meiosis. Occasionally observations such as the configuration shown in Plate 1262, fig. 5 in which there is very considerable fragmentation suggests the possibility of a relationship between the abnormal zygotenes and pachytenes and the cells showing the chromatin pieces. Similar extreme fragmentation beginning at first metaphase is reported by Gentcheff and Gustafsson (1940) in an apomict, *Hieracium robustum*.

c. Populations examined so far quite consistently have revealed a first anaphase bridge and fragment suggesting heterozygosity for an inversion in what appears to be the median attached chromosome (Plate 1262, fig. 6).

d. Chromosome interlocking as illustrated in Plate 1262, fig. 4 also occurs occasionally.

3. *Chiasma frequency:* Counts of the chiasma frequency at diakinesis were made in samples of both the 1954 and 1959 material. The average of the former year is $10.9 \pm .83$ and the latter year $11.6 \mp .86$, the difference not being significant. Some terminalization takes place between early diakinesis and first metaphase but the number of chiasmata is not notably decreased till the beginning of first anaphase.

4. *Tapetal cells:* It is quite common for the tapetal cells in plants to show considerable aberration with reference both to mitosis and number of chromosomes (D'Amato,

1952). *P. peltatum* is particularly good material for illustrating aberrations. Some of the more striking ones are shown in Plate 1264. The tapetal cells begin division concurrent with the onset of meiosis and these first divisions are generally normal. By diplotene, tapetal divisions begin to show abnormalities in the form of scattered metaphase configurations and the frequency of divisions is on the increase. Between first metaphase and second prophase, the rate of mitosis in the tapetum seems to reach its peak and also the degree of aberration has increased considerably. Polyploidy is very common now, often to the octoploid level and in a few cases probably much higher. In some apparent-

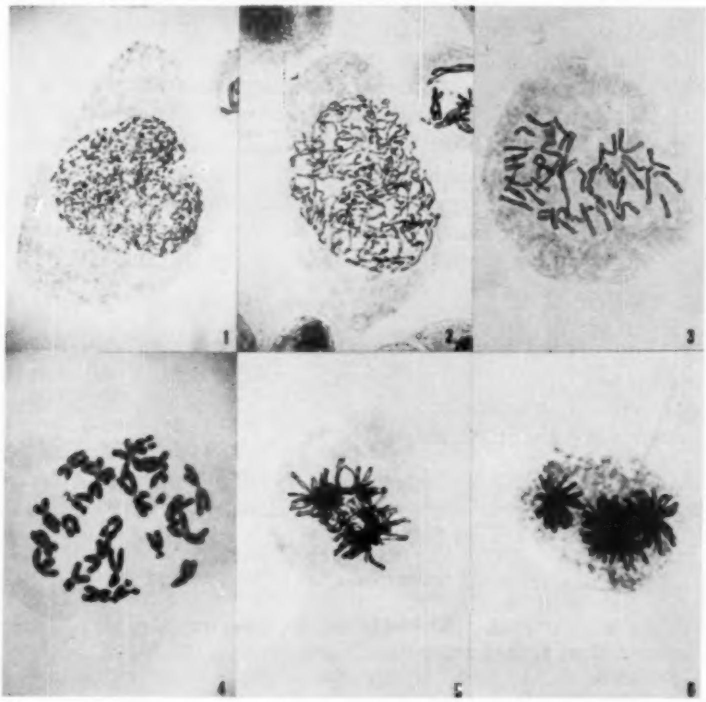

PLATE 1264. Abnormal stages in mitosis of the tapetum. Fig. 1-2. Polyploid prophase. Fig. 3. Polyploid metaphase. Fig. 4. "Scattered" metaphase. Fig. 5. Metaphase. Fig. 6. Tri-polar anaphase.

ly clear cases the number is not an exact multiple of the basic number but one or more chromosomes is missing. Other characteristics are multinucleate cells with varying numbers of chromosomes in the different nuclei, star metaphases, star anaphases with three or more centers of aggregation. By the time tetrads are formed there is a definite decrease in the tapetal divisions and an over-all multinucleate condition exists in the interphases of this tissue. Indeed almost all of the mitotic aberrations which have been associated with chemical treatments or described for cancer cells are characteristically found in the tapetal cells of this plant.

The question may be asked whether the abnormalities of the tapetum arise as a result of its function. In her studies on *Solanum tuberosum* Avanzi (1950) suggests that the tapetum definitely has a nutritive function and that the abnormalities especially in chromosome number, occur at the time when the sporogenous tissue needs its greatest food supply. Taylor (1959) working on *Lilium longiflorum* came to the conclusion that the primary function of the tapetal layer is to secrete material for wall formation of the microspores. Further work needs to be done on this intriguing phenomenon in the tapetum to determine its cause.

SUMMARY

The above account describes microsporogenesis in anthers of *Podophyllum peltatum* L. and the concurrent mitotic activity of the tapetum. Some peculiarities related to these events are also mentioned.

AVANZI, M. G. 1950. Endomitosi e mitosi a diplocromosomi nello sviluppo delle cellule del tappeto di *Solanum tuberosum* L. Caryologia **2**: 205-222.

COOPER, D. C. 1952. The transfer of desoxyribonucleic acid from the tapetum to the microsporocytes at the onset of meiosis. Amer. Naturalist **86**: 219-229.

D'AMATO, F. 1952. Polyploidy in the differentiation and function of plant tissues and cells. Caryologia **4**: 311-358.

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SPARROW, A. H. AND M. R. HAMMOND. 1947. Cytological evidence for the transfer of desoxyribose nuclei acid from nucleus to cytoplasm in certain plant cells. Amer. J. Bot. **34**: 439-445.

TAKATA, S. T. 1959. Chromatin extrusion and DNA transfer during microsporogenesis. Chromosoma **10**: 430-453.

TAYLOR, J. H. 1959. Autoradiographic studies of nucleic acids and proteins during meiosis in *Lilium longiflorum*. Amer. J. Bot. **46**: 477-484.

A LIST OF ALGAE FROM SELECTED AREAS IN MASSACHUSETTS[1]

EDGAR E. WEBBER

For the past thirty years, work on the flora of Worcester County has been centered upon vascular plants. Numerous references may be found elsewhere. Recently, attention has been directed to other forms of plant life (1, 3). However, little is known concerning the algae of the county. In 1899 Stone (6) included a list of algae found in Lake Quinsigamond as part of a floristic study of that area. Auyang (2) has recently completed a survey of the algae in Lake Quinsigamond. These two works appear to be the only ones to date dealing with the algal flora of the county, but they both are restricted to only one location.

The writer (7) has just completed an ecological study of the algal populations in eleven selected stations in Worcester

[1]The taxonomic list, slightly modified, from a thesis, "The Ecology of Some Attached Algae in Worcester County, Massachusetts," presented to the Faculty of the Graduate School of Cornell University in partial fulfillment of the requirements for the degree of Master of Science.

County. No attempt will be made here at ecologically characterizing these stations; a listing of them will suffice.

STATION	NAME AND LOCATION
1	Eames Pond, Oxford, Mass.
2	Eddy Pond, Auburn, Mass.
3	The Cataracts, Worcester, Mass.
4	Silver Spring Brook, Paxton, Mass.
5	The Quag, Sterling, Mass.
6	Chaffin Pond, Holden, Mass.
7	Brook near Reservoir no. 4., Paxton, Mass.
8	Stream near Reservoir no. 2., Leicester, Mass.
9	Indian Lake, Worcester, Mass.
10	A tire depression, temporary habitat, near station 9.
11	Sargent Pond, Leicester, Mass.

Following is a list of algal species collected in Worcester County during the course of the ecological study mentioned above (7). The collecting station appears in parentheses after each species. The taxonomic scheme is that used by Prescott (4); the desmids and diatoms, since they are not included in Prescott (4), are classified following Smith (5).

CHLOROPHYTA

CHLAMYDOMONADACEAE: Chlamydomonas sp. (6).

VOLVOCACEAE: Pandorina morum (Muell.) Bory (2-b, 5-a, 5-b); Gonium sociale (Duj.) Warming (10).

HAEMATOCOCCACEAE: Haematococcus sp. (5; isolated pockets along shore).

ULOTRICHACEAE: Ulothrix subconstricta G. S. West (11-b); U. tenerrima Kuetz. (3, 7-a); U. variabilis Kuetz. (6, 7-a, 11-b); U. sp. (? cylindricum) Prescott (7-a); Binuclearia tatrana Wittr. (11-a).

MICROSPORACEAE: Microspora tumidula Hazen (7-a); M. sp. (4).

CYLINDROCAPSACEAE: Cylindrocapsa geminella var. minor Hansg. (5-a).

CHAETOPHORACEAE: Stigeoglonium aestivale (Hazen) Collins (1-b); S. lubricum (Dillw.) Kuetz. (2-a, 7-b); S. tenue (Ag.) Kuetz. (8-c); S. sp. (? glomeratum (Hazen) Collins or subsecundum Kuetz.) (7-b).

COLEOCHAETACEAE: Coleochaete scutata Breb. (5-a); Chaetosphaeridium globosum Klebahn (6); Draparnaldia glomerata (Vauch.) C.A. Ag. (8-a); Aphanochaete repens A. Br. (11-a).

CLADOPHORACEAE: Rhizoclonium hieroglyphicum (Ag.) Kuetz. (2-a).

OEDOGONIACEAE: Bulbochaete scrobiculata Tiff.) Tiffany (11-a); B. sp. (? elatior) Prings. (11-a); B. sp. (? mirabilis) Wittr. (11-a); B. sp. (? setigra (Roth) C.A. Ag. or insignis Prings.) (11-a); Oedogo-

nium boscii (LeCl.) Wittr. (3); O. gracilius (Wittr.) Tiff. (6); O. reinschii Roy (6); O. subsexangulare Tiff. (11-a); O. sp. (? hystricinum Trans. & Tiff.) (11-b); O. sp. (1-a, 1-b, 2-a, 2-b, 5-b).

CHLOROCOCCACEAE: Golenkinia paucipina West & West (2-b).

CHARIACEAE: Characium ambiguum Herm. (1-a, 2-a, 7-a, 7-b); C. naegelii A. Br. (7-b, 8-b); C. stipitatum (Bachm.) Wille (11-a); C. sp. (? pringsheimii) A. Br. (6).

HYDRODICTYACEAE: Pediastrum araneosum var. rugulosum (G. S. West) G. M. Smith (6); P. biradiatum Meyen (2-b); P. boryanum (Turp.) Meneg. (1-a, 2-a, 2-b, 5-a, 6, 11-a); P. boryanum var. longicorne Raciborski (5-a); P. boryanum var. undulatum Wille (1-a); P. duplex Meyen (1-a, 6); P. duplex var. clathratum (A. Br.) Lag. (1-a, 2-a); P. duplex var. cohaerens Bohl. (6); P. duplex var. gracillimum West & West (11-b); P. obtusum Lucks (6, 11-b); P. sculptatum G. M. Smith (5-a); P. tetras (Ehr.) Ralfs (1-a, 2-a, 2-b, 5-a, 5-b, 6, 11-a); P. tetras var. tetraodon (Corda) Rab. (1-c, 5-a, 5-b, 6, 11-a, 11-b); Sorastrum americanum (Bohl.) Schmidle (6); S. americanum var. undulatum G. M. Smith (6, 11-b); S. spinulosum Naeg. (6).

COELASTRACEAE: Coelastrum cambricum Arch. (2-a, 11-b); C. microporum Naeg. (2-a, 5-a, 6, 8-a, 11-a, 11-b); C. sphaericum Naeg. (1-c, 2-a, 2-b).

OOCYSTACEAE: Dictyosphaerium pulchellum Wood (2-a); Trochiscia obtusa (Reins.) Hansg. (6); T. reticularis (Reins.) Hansg. (6, 8-b); T. sp. (1-b, 4, 5-b); Eremosphaeria viridis DBy. (6); Oocystis crassa Wittr. (6); O. elliptica W. West (6); O. solitaria Wittr. (6); Nephrocytium agardhianum Naeg. (5-a, 6, 11-b); N. obesum West & West (6); Dimorphococcus lunatus A. Br. (6); Ankistrodesmus convolutus Corda (2-a); A. falcatus (Corda) Ralfs (1-c, 6, 11-a); A. falcatus var. acicularis (A. Br.) G. S. West (11-a); A. falcatus var. mirabilis (West & West); G. S. West (2-a); A. spiralis (Turner) Lem. (6, 8-a); Selenastrum minutum (Naeg.) Collins (5-a, 11-a); S. sp. (6); Kirchneriella lunaris (Kirch.) Moebius (6); K. obesa var. major (Barnard) G. M. Smith (2-a, 6); K. subsolitaria Schmidle (2-a, 6); Quadrigula lacustris (Chod.) G. M. Smith (6, 11-b); Tetraedron caudatum (Corda) Hansg. (6, 11-b); T. minimum (A. Br.) Hansg. (2-a, 2-b, 11-a, 11-b); T. obesum (West & West) Wille (6); T. trigonum (Naeg.) Hansg. (6); T. tumidulum (Reins.) Hansg. (11-b).

SCENEDESMACEAE: Scenedesmus abundans (Kirch.) Chod. (2-a, 2-b); S. acuminatus (Lag.) Chod. (8-a); S. acutiformis Schroeder (1-a, 2-a, 2-b, 6, 11-b); S. arcuatus Lem. (2-a, 6); S. arcuatus var. capitatus G. M. Smith (2-b); S. arcuatus var. platydisca G. M. Smith (2-a, 6, 11-a, 11-b); S. armatus (Chod.) G. M. Smith (6); S. bijuga (Turp.) Lag. (1-a, 2-a, 2-b, 5-a, 5-b, 6, 8-a, 8-b, 11-a); S. bijuga var. alternans (Reins.) Hansg. (6); S. brasiliensis Bohlin (1-c, 2-b, 8-b, 11-b); S. carinatus (Lom.) Chod. (1-a); S. caudatus Corda (1-c, 2-a); S. caudatus var. typicus Kirch. (1-c); S. denticulatus Lag. (2-a, 2-b, 6, 8-a);

S. dimorphus (Turp.) Kuetz. (1-a, 2-a, 2-b, 6, 8-b); S. incrassatulus Bohlin (1-a); S. longus Meyen (5-b); S. obliquus (Turp.) Kuetz. (2-a, 2-b, 5-a, 6, 8-a); S. opoliensis P. Richter (2-b); S. quadricaudata (Turp.) Breb. (1-a, 1-c, 2-a, 2-b, 5-a, 5-b, 6, 8-a, 11-b); S. quadricaudata var. parvus G.M.Smith (1-a); S. quadricaudata var. quadrispina (Chod.) G. M. Smith (5-b); S. quadricaudata var. westii G. M. Smith (2-a, 5-b); Actinastrum sp. (? hantzchii) Lag. (2-a); Tetradesmus wisconsinense G. M. Smith (6).

ZYGNEMATACEAE: Mougeotia scalaris Hass. (8-b); M. sp. (1-a, 1-b, 1-c, 2-b, 5-a, 6, 7-a, 7-b, 8-a, 8-b, 8-c, 11-b); Spirogyra hyalina Cleve (6); S. rivularis Rab. (2-b); S. sp. (1-a, 1-b, 2-a, 2-b, 2-c, 5-a, 5-b, 6, 7-b, 8-b, 11-b); Zygnema sp. (1-a, 1-b, 5-a, 5-b, 6, 8-a, 8-b, 11-b); Zygnemopsis desmidioides (West & West) Transeau (5-a).

MESOTENIACEAE: Gonatozygon aculeatum Hastings (6); G. brebissonii Meneg. (11-a); Cylindrocystis americana West (8-c); C. brebissonii Meneg. (11-a); Netrium digitus (Ehr.) Itz. & Rothe (1-c, 5-a, 5-b, 6, 8-c); N. digitus var. constrictum West & West (6); N. naegelii (Breb.) West & West (6, 8-b); N. sp. (? oblongum) (DBy) Luet. (8-b); Spirotaenia condensata Breb. (1-a).

DESMIDIACEAE: Closterium abruptum West (6); C. acerosum (Schrank) Ehr. (6); C. acuminatum Ralfs (1-c, 3, 4); C. cornu Ehr. (11-a); C. ehrenbergii Meneg. (5-a); C. jenneri Ralfs (1-c, 2-a, 2-b, 4); C. juncidum Ralfs (6); C. lanceolatum Kuetz. (6); C. leibleinii Kuetz. (1-a, 5-b, 6, 7-a); C. libellula Focke (1-a, 5-b); C. libellula var. intermedium Roy & Bis. (6); C. moniliferum Ehr. (4, 6, 8-b, 8-c); C. parvulum Naeg. (1-c, 3, 5-a, 5-b, 6, 8-b, 8-c, 11-a); C. regulare Breb. (6); C. rostratum Ehr. (1-a, 4, 5-a); C. setaceum Ehr. (6, 11-b); C. strigosum Ehr. (6); C. subtruncatum West & West (6); C. venus Kuetz. (1-a, 3, 6, 8-b); Penium navicula Breb. (6); P. sp. (? closteroides) Ralfs (1-b); P. sp. (6); Pleurotaenium coronatum (Breb.) Rab. (6); P. maximum (Reins.) Lund (11-a); P. trabecula (Ehr.) Naeg. (5-a, 5-b, 6); Triploceras gracile Bail. (6); Euastrum abruptum Nord. (1-c, 6); E. abruptum forma minus West & West (11-a, 11-b); E. bidentatum Naeg. (6); E. binale (Turp.) Ehr. (6); E. binale forma minor G. S. West (11-a); E. elegans Kuetz. (3, 5-a, 11-a); E. evolutum West & West (6); E. evolutum var. integrius West & West (6); E. gemmatum Breb. (6); E. insulare (Wittr.) Roy (3, 6, 11-b); E. pictum Borg. (1-a); E. pulchellum Breb. (6, 11-a, 11-b); E. sinuosum var. reductum West & West (11-a, 11-b); Cosmarium amoenum Breb. (5-b, 6); C. amoenum var. tumidum Wolle (6); C. bioculatum Breb. (11-a, 11-b); C. boeckii Wille (3, 6, 11-a, 11-b); C. botrytis Meneg. (2-a); C. broomei Thwaites (1-a); C. circulare Reins. (1-c, 6, 8-c); C. coelatum Ralfs (3); C. connatum Breb. (6); C. contractum Kirch. (2-a, 6); C. excavatum Nord. (6); C. galeritum Nord. (2-a); G. globosum Bulnh. (5-a, 6); C. impressulum Elfv. (6); C. intermedium Delp. (5-a, 5-b); C. margaritatum (Lund) Roy & Bis. (5-a, 6); C. moniliforme (Turp.)

Ralfs (1-a); C. meneghinii Breb. (5-a, 6); C. naeglianum Breb. (6); C. nitidulum DeNot. (5-a); C. orbiculare Ralfs (5-b, 6); C. ornatum Ralfs (2-a); C. ornatum var. protractum Wolle (1-a); C. pachydermum Lund (6); C. portianum Arch. (1-a, 6, 11-b); C. punctulatum Breb. (6); C. pyramidatum Breb. (6); C. quadrum Lund (6); C. regnelii Wille (11-b); C. regnesii Reins. (6, 11-b); C. renniforme (Ralfs) Arch. (11-a); C. repandum forma minor West & West (6); C. speciosum Lund (2-a); C. sublobatum Arch. (6); C. tumidum Lund (6); C. undulatum Corda (1-a, 1-c, 2-a, 3, 5-a, 5-b, 6, 8-c, 11-a, 11-b); C. undulatum var. minutum Wittr. (5-a); C. undulatum (? var. wollei) West (5-b, 11-a); C. viride (Corda) Josh. (5-a, 6); C. sp. (? gonatum) Breb. (2-a); C. sp. (? pseudoconnatum) Nord. (8-c); Micrasterias americana (Ehr.) Ralfs (1-c); M. laticeps Nord. (6); M. mahabuleswarensis Hobson (5-a); M. pinnatifida (Kuetz.) Ralfs (6); M. radiata Hass. (5-b, 6); M. sol (Ehr.). Kuetz. (6); M. truncata (Corda) Breb. (5-a, 5-b); Xanthidium antilopaeum (Breb.) Kuetz. (1-b, 6); X. antilopaeum var. minneapoliense Wolle (6); X. antilopaeum var. polymazum Nord. (5-a, 6); Staurastrum alternans Breb. (3); S. arctison var. glabrum West & West (5-b); S. aspinosum Wolle (6); S. bienianum var. ellipticum Wolle (5-b); S. brebissonii Arch. (6); S. brevispinum Breb. (5-a, 11-a); S. crenulatum (Naeg.) Delp. (6); S. dejectum Breb. (5-a); S. dickiei Ralfs (5-b); S. dilatatum Ehr. (2-a, 5-a, 5-b); S. gracile Ralfs (2-a, 5-a, 5-b, 6); S. granulosum (Ehr.) Ralfs (11-b); S. leptocladum Nord. (1-a, 5-a, 5-b, 6, 11-b); S. leptocladum var. divergens Nord. (1-c, 6); S. margaritaceum (Ehr.) Meneg. (5-a); S. megacanthum Lund (6, 11-a); S. odontatum Wolle (6); S. paradoxum Meyen (11-a); S. pilosum Arch. (3); S. tetracerum Ralfs (6); Arthrodesmus convergens Ehr. (6); A. incus (Breb.) Hass. (1-c, 11-a); A. incus var. extensus Anderson (11-b); A. octocornis Ehr. (11-a, 11-b); A. triangularis Lag. (11-a, 11-b); Spondylosium papillosum West & West (11-a, 11-b); S. planum (Wolle) West & West (6, 11-a, 11-b); S. pulchellum Arch. (11-a, 11-b); S. pulchrum (Bail.) Arch. (6); Hyalotheca dissiliens (Smith) Breb. (5-a, 6, 8-c); H. undulata Nord. (6); Onychonema filiforme (Erh.) Roy & Bis. (6); Sphaerozosma excavatum Ralfs (6); S. filiforme Rab. (6); S. granulatum Roy & Bis. (6, 11-a); Desmidium aptogonum Breb. (6); D. baileyi (Ralfs) Wolle (6); D. grevelii (Kuetz.) DBy. (6); D. longatum Wolle (6); D. swartzii Ag. (6); Gymnozyga moniliformis Ehr. (6); G. moniliformis var. gracilescens Nord. (6).

CHRYSOPHYTA

CHLOROTHECIACEAE: Ophyiocytium capitatum Wolle (11-a, 11-b); O. parvulum (Perty) A.Br. (6, 11-a, 11-b); O. sp. (1-c, 2-a).

TRIBONEMATACEAE: Tribonema bombycinum (C.A. Ag.) Derbes & Solier (6, 7-a, 8-a); T. minus (Wolle) Hazen (2-a, 5-a, 7-b, 8-b).

VAUCHERIACEAE: Vaucheria sp. (1-b, 3, 6, 8-c).

OCHROMONADACEAE: Dinobryon sp. (6).

RHIZOCHRYSIDACEAE: Lagynion sp. (? ampullaceum) (Stokes) Pascher (6).

COSINODISCACEAE: Melosira sculpta Kuetz. (8-b, 8-c); M. varians C. A. Ag. (2-b); Stephanodiscus sp. (8-a).

TABELLARIACEAE: Tabellaria fenestrata (Lyngb.) Kuetz. (1-a, 1-c, 2-b, 3, 7-a, 8-a, 11-a); T. fenestrata (? var. asterionelloides) Grun. (1-c); T. flocculosa (Rothe) Kuetz. (1-a, 1-c, 3, 4, 5-a, 7-a, 8-a, 11-a).

MERIDIONACEAE: Meridion circulare (Grev.) Ag. (1-c, 2-a, 3, 4, 7-a); M. intermedium H. L. Smith (1-c, 3, 7-a).

DIATOMACEAE: Diatoma anceps (Ehr.) Kirch. (4).

FRAGILARIACEAE: Fragilaria sp. (? capucina) Desmaz. (1-a, 1-c, 2-a, 3, 4, 5-a, 7-a, 8-a, 11-a); Synedra acuta Ehr. (1-c, 3, 4, 8-a); S. radians Kuetz. (2-a, 8-e, 11-a); S. ulna (Nitzsch) Erh. (3); S. ulna var. biceps (Kuetz.) Schoen. (8-a); S. ulna var. danica (Kuetz.) Grun. (4, 8-a, 8-b, 8-c).

EUNOTIACEAE: Eunotia robusta var. diadema (Ehr.) Ralfs (11-a); E. robusta var. tetrodon Ralfs (3).

NAVICULACEAE: Navicula diaphala (Ehr.) W. Smith (5-a); N. sp. (1-a, 3, 4, 5-a, 7-a, 7-b, 8-b, 8-c, 10); Stauroneis inflata Kuetz. (8-c); S. sp. (3).

GOMPHONEMATACEAE: Gomphonema acuminatum var. coronatum (Ehr.) Ralfs (11-a, 11-b); G. constrictum Ehr. (2-a, 11-a); G. dichotomum Kuetz. (7-b, 8-b); G. geminatum (Lyngb.) C.A. Ag. (7-a, 11-a); G. sp. (1-a, 1-b, 8-b).

CYMBELLACEAE: Cymbella sp. (3, 4, 5-a); Epithemia sp. (5-b).

SURIRELLACEAE: Surirella sp. (4).

EUGLENOPHYTA

EUGLENACEAE: Euglena polymorpha Dangeard (6, 10); E. sp. (3, 5-a, 5-b, 6, 10); Phacus sp. (3, 5-a); Trachelomonas hispida (Perty) Stein (6).

PYRRHOPHYTA

PERIDINIACEAE: Peridinium cinctum (Muell.) Ehr. (6).

CYANOPHYTA

CHROOCOCCACEAE: Microcystis aeruginosa Kuetz. (2-a, 2-b, 2-c, 9, 11-a); M. incerta Lem. (9); Merismopedia glauca (Ehr.) Naeg. (5-a, 5-b); M. tenuissima Lem. (6); Aphanothece castagnei (Breb.) Rab. (6); Coelosphaerium collinsii Drouet & Daily (11-a); Marssoniella elegans Lem. (6); Glaucocystis nostochinearum (Itz.) Rab. (6, 11-a); G. oocystiformis Prescott (6).

OSCILLATORIACEAE: Spirulina laxa G. M. Smith (6); S. sp. (5-a); Trichodesmium lacustre Kleb. (3); Oscillatoria agardhii Gomont (11-b); O. amphibia C.A. Ag. (11-a); O. articulata Gardner (1-a, 11-b); O. curviceps C.A. Ag. (6); O. lacustris (Kleb.) Geitler (3); O. sancta (Kuetz.) Gomont (6); O. subtilissima Kuetz. (6); O. tenuis C.A. Ag. (1-c, 8-a, 8-c, 10); O. sp. (? angusta) Koppe (8-b); Phormidium inun-

datum Kuetz. (1-b, 2-a, 4, 11-b); P. retzii (C.A. Ag.) Gomont (4, 8-b, 11-b); Lyngbya aerugineo-coerulea (Kuetz.) Gomont (3).

NOSTOCACEAE: Anabaena affinis Lem. (2-a, 2-b, 2-c, 5-a); A. flos-aquae (Lyngb.) Breb. (11-a); A. oscillarioides Bory (8-c); A. spiroides Kleb. (9).

SCYTONEMATACEAE: Hapalosiphon hibernicus West & West (6); Stigonema mamillosum (Lyngb.) C.A. Ag. (11-a).

RIVULARIACEAE: Gloeotrichia echinulata (J.E. Smith) P. Richter (6); Calothrix epiphytica West & West (5-b).

RHODOPHYTA

CHANTRANSIACEAE: Audouinella sp. (4).

BATRACHOSPERMACEAE: Batrachospermum vagum (Roth) C.A. Ag. (4). — DEPT. OF BOTANY, CORNELL UNIVERSITY, ITHACA, N. Y.

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FURTHER NOTES ON CHAMAECYPARIS THYOIDES IN NEW HAMPSHIRE

HENRY I. BALDWIN

H. K. Svenson (Rhodora **31**: 96-98, 1929) describes his three visits to the towns of Bradford, Windsor and Washington, N. H. when he located *Chamaecyparis thyoides* (L.) BSP., in Bradford near the Washington line, presumably along the highway from East Washington to Bradford Center, and at Black Pond and Bagley's Pond in Windsor. He failed to find any stations for this species in the town of Washington, although he and Prof. Fernald made a considerable search for it. Recently, in connection with explora-

tions made for the purpose of acquiring an area where this species might be preserved, the following observations were made. As mentioned by Svenson, this tree is continually being cut for posts and poles, and is fast disappearing. Flooding by beaver dams as well as man-made dams has also taken its toll.

1. *Bradford swamp* adjoining Bradford Mineral Springs is one of the most extensive habitats. It extends from the highway between East Washington and Bradford Center, south to the Bradford-Hillsboro town line and farther along the brook into Hillsboro a considerable distance, where cedar is found today as widely separated single specimens. Along the western side of the swamp near the Bradford-Washington line there still remain clumps of larger trees up to 10″ in diameter, with scattered smaller trees on the fringes of areas clear-cut in 1958. No trees have been found in Washington; it seems probable that collections labelled "East of East Washington Village" were actually made in Bradford. The eastern side of the swamp also contains at least one untouched stand on the fringe of an open black spruce bog. Some cedar is to be found north of the highway near the northern margin of the swamp.

2. *Mud Pond* (also known as Ayers or Nichols Pond) elevation 900′ (area 4.6 acres of which 3 are in Hillsboro) through which the Bradford-Hillsboro town line passes, has long been known to the writer as a station for cedar. When visited over 20 years ago the impression was gained that an extensive stand of fairly large trees surrounded the pond. Possibly these have since been cut. When visited in March 1961 the following observations were made: A small clump of cedar is situated on the southwest border of the pond. The trees are small — mostly 1″ to 4″ in diameter. There is also one small tree on the southeast shore, and one 5″ tree on the east shore. All these are in the town of Hillsboro. There are also four trees along the northeast shore lying in Bradford. Carter Pond at the same elevation, and ringed by black spruce bog, apparently an identical habitat, was searched but no cedar found.

3. *Bagley's Pond*, mentioned by Svenson as a station, lies partly in Windsor and partly in Hillsboro at an elevation of 1,146′. It is 40 acres in extent, of which only three acres are in Hillsboro near the outlet. This was visited on March 26, 1961 and as in the case of the other areas, explored on skis on a hard crust. It was easy to cover all the shore line and the swampy areas at the inlet and outlet. No trace of cedar was found. The water level appeared to have been raised about two feet by a beaver dam at the outlet at some time in recent years and pine, spruce, hemlock and some hardwoods killed, especially in the swamp around the inlet at the west end. A thorough search of this area failed to disclose any dead cedar or stumps. Since Svenson mentioned finding cedar in Bagley's Pond in Windsor, it was presumably in this area where the trees occurred.

4. *Black Pond* in Windsor, elevation 1058′ (area 39 acres) has two main inlets on the south and west bordered by extensive swamps. The water level was raised many years ago for a mill at the outlet, the present site of Windsor Mt. Camps. The dam has been repaired and maintained by the camp. The shores are rather steep in the main part of the pond and no cedar is encountered until one passes the principal island. Part of swamps around the inlets are occupied by cedar of small size, mostly 1″ to 4″ in diameter, growing in thick clumps, usually associated with old stumps of the original cedar that was cut many years ago. The living trees are not over 10 feet in height. Mingled with these are numerous dead cedars of larger size (5″-6″ diameter and 20′ high) that may have been left in the original cutting and killed when the dam was built. All the presently living trees are in water, but the level must drop sufficiently in summer to permit them to survive. Some of the older stumps are one to two feet in diameter. Sections cut from these showed that growth had been extremely slow. One large stump had grown 0.3 inches during the last 10 years; 0.45 inches between 10 and 20 years, and 0.6 inches from the 20th to 30th year, counting back from the bark. Allowing for more rapid growth in youth this would still make it over

100 years old. A 6″ standing dead cedar averaged about 20 rings per inch. Nearby White Pond in Windsor and Stoddard was explored but no cedar found.

5. *Swamp NW of Loverens Mill* on Route 9, Antrim, N. H., elevation 1,036′. This extends for one mile north to the Windsor town line, and is separated from the Black Pond bog by a low height-of-land. Cedar is abundant in the poorly drained portions, disappearing wherever water movement becomes pronounced. It grows in mixture with black spruce *Picea mariana*, red maple and occasional white pine. There is no evidence of cutting in the southern portion, the only part visited. The largest cedars are 6″ to 8″ d.b.h. and younger, smaller trees are scarce due to the dense stand. The extent of the cedar area was not determined.

6. *Robb Reservoir* in Stoddard, elevation 1,275′. Cedar may be seen along the highway from Route 123, about 1 mile south of South Stoddard. This is a swamp at the south end of the Reservoir. Again the cedar occurs in mixture with black spruce and shrubs. (No cedar was found at the outlet or along the shores of Rye Pond in Nelsona short distance to the SE.) Cedar at the Stoddard site was commonly infected with *Gymnosporangium biseptatum*.

Apparently *Chamaecyparis* has not been previously reported from Antrim, Hillsboro or Stoddard, N. H. Hodgdon & Steele[1] do not list these towns. Specimens from these areas have been deposited in the herbaria of the N. E. Botanical Club and the University of New Hampshire.

This tree was found only in wet bogs or swamps with standing water the year round, and with imperfect drainage. Where water movement was evident no cedar was found. Common associated species were black spruce, *Picea mariana* (Mill.) BSP., tamarack, *Larix laricina* (Du Roi) K. Koch, red maple, *Acer rubrum* L., mountain holly, *Nemopanthus mucronata* (L.) Trel., highbush blueberry, *Vaccinium corymbosum* L. and cassandra, *Chamaedaphne calyculata* (L.) Moench. all growing in sphagnum. While cedar was found under these conditions, and in association with these

[1]Hodgdon, Albion R. and Frederic L. Steele, 1958. The Woody Plants of New Hampshire, Bull. 447, N. H. Agr. Exp. Sta.

species, the converse was not true. There are numerous other sites with apparently identical habitat conditions where cedar has not been found. It may very likely occur in other places not yet examined. Certainly it is not possible to state that *Chamaecyparis* does *not* occur in a township without a very detailed survey.

This brief survey of *Chamaecyparis* at its known north-western limit in New Hampshire serves to indicate the precarious status of plants that cannot maintain themselves when the environment is altered. Reproduction is scanty, growth is slow and is inadequate to restore stocking when cutting and flooding destroy the seed bearing trees. Unless some areas are placed under protection it will be only a matter of time before all *Chamaecyparis* disappears from this region, as it apparently already has from Bagley's Pond. — FOX RESEARCH FOREST, HILLSBORO, NEW HAMPSHIRE.

WHICH SIDE IS UP? A LOOK AT THE LEAVES OF ORYZOPSIS

EDWARD G. VOSS

It was no less noted a critic than M. L. Fernald who asserted: "errors once born never die but, on the contrary, by others not situated to know the facts are continually mistaken for the truth and consequently perpetuated." (Rhodora **44**: 246. 1942.) After examination of a long series of Michigan specimens of a grass common in dryish woods throughout the state, *Oryzopsis asperifolia* Michx., I was not a little surprised to read in Fernald's 8th edition of Gray's Manual (1950) that the leaves of this species have a "*glaucous lower surface*" (italics are the original emphasis).

Professor Fernald is in good, if not accurate, company. The first edition of Gray's Manual (1848) described the leaves as "pale underneath," and they have been similarly described in all subsequent editions. Torrey's great Flora of New York (1843) — a source in which I often find accurate bits of description omitted by other authors — considers the leaves "glaucous underneath." The official verdict

of the Manual of Grasses (1935 & 1951 editions) is "glaucous beneath." Gleason's New Illustrated Flora (1952) says "pale . . . beneath." Harrington (Man. Pl. Colo., 1954) uses the phrase "rather glaucous below."

The embarrassing fact is that it is the *upper* (adaxial) surface of the leaf blades (a conspicuous 4-10 mm wide) which is glaucous. The truth is readily determined by following a blade as it extends from the sheath. In his original description, Michaux said nothing about glaucousness, and I do not know who started the error; possibly it was Torrey. Many authors, whether intentionally or not, have kept their records clean by declining to report on this point: Pursh, Bigelow, Eaton, Wood, Britton & Brown, etc.

The typically careful Deam (Grasses Ind., 1929) does not mention glaucousness, but does describe the blades as involute at the base, thus revealing his correct observation of the orientation of the leaf. (Descriptions of the margins as "revolute" show the same lack of understanding of which side is up.) Jennings (Wild Fl. West. Pa. & Upper Ohio Basin, 1953) merely describes the leaves as "glaucous," not committing himself as to surface. In a cursory examination of literature, I have found no one who actually describes the upper surface as glaucous.

Species possessing leaves with revolute margins and a glaucous under surface are not unusual. Involute margins and a glaucous upper surface would ordinarily, to be sure, be unexpected, although the leaves of *Oryzopsis pungens* (Spreng.) Hitchc. are almost universally described as very narrow and involute and one might therefore expect that in *O. asperifolia* they are simply wide and involute. Assuming that some, if not all, authors have based their mention of a glaucous surface on an examination of plants and not on second-hand information, apparently the examination was not extended to checking just which side of the leaf was being observed. This is one case in which herbarium specimens are more easily interpreted than plants growing in the field. For in the latter, the leaves (essentially basal) spread out loosely over the ground, with the glaucous upper surface

usually appearing falsely to be the lower one, as the tough evergreen blades turn on their very narrow, involute, nearly terete, and evidently weak bases. However, one may easily trace the adaxial surface with the naked eye from the inside of the sheath, past the tiny ligule, through the groove in the slender base of the blade, to the broad glaucous surface with usually involute margins.

The leaves of *Oryzopsis racemosa* (Sm.) Hitchc., being cauline rather than basal, and even more conspicuous, have fared a little better in manuals and the score is nearly even. The Manual of Grasses says "pubescent beneath," and Gleason uses the identical phrase. Torrey (under the synonym *O. melanocarpa*) again disappoints us, with "pubescent underneath." Deam, however, says "pubescent above," as does Fernald in the 8th edition of Gray's Manual, and as did the 7th edition (earlier ones omitting the point). Jones (Fl. Ill., 1950) says "the upper surface pubescent." On all specimens which I have examined, the leaf blades are characteristically short-pilose *above*, although there is sometimes a little pilosity below in addition.

If a moral is to be drawn from these simple observations, it is that those who write local floras have no basis for an accurate product other than painstaking examination of "nature, not books." — HERBARIUM, UNIVERSITY OF MICHIGAN, ANN ARBOR.

A CHECK LIST OF WALTER DEANE'S SEEDLING COLLECTION

RICHARD J. EATON

The extensive and beautifully prepared herbarium of Walter Deane came to the New England Botanical Club by bequest in 1931. It included a bundle which he had designated as his "Seedling Collection" made in 1895 or thereabouts. It consists of meticulously prepared and well-mounted specimens representing fifty-two species in forty-three genera. For each species there are from one to five or more sheets with the specimens arranged in sequence according to age

from cotyledon stage onwards. In many cases a fruiting specimen from the putative parent plant is exhibited as a voucher; in others, a specimen in similar condition collected from the immediate vicinity. In every instance mature identifiable material accompanies the seedlings. Mr. Deane's label data and supplementary field notes are convincing: one is persuaded to accept the identifications without skepticism.

It has been decided to insert this collection, appropriately segregated in separate species covers, in the organized herbarium of the Club. Before doing this, the appended check list was prepared, the nomenclature being revised to conform to that of Gray's Manual, 8th Edition. Without such a list the collection would be effectively lost among the eleven thousand or more species covers which enfold the two hundred thirty thousand mounted sheets in the Club herbarium. Actually, I think that a portion of the original collection, or perhaps a supplement to it, has been "lost" in this manner, because I have encountered from time to time an occasional sheet of seedlings labeled in Mr. Deane's well-known handwriting. From now on a record of such encounters should be kept so as to build up as complete a check list of the Deane seedlings as possible.

1. Abies balsamea
2. Picea mariana
3. Pinus Strobus
4. Alisma triviale
5. Betula lutea
6. Ulmus americana
7. Polygonum aviculare
8. P. Persicaria
9. P. orientale
10. P. Convolvulus
11. P. scandens
12. Chenopodium album
13. Atriplex patula var hastata
14. Salicornia europaea
15. Salsola kali
16. Amaranthus retroflexus
17. Portulaca oleracea
18. Spergularia marina
19. Stellaria media
20. Silene Cucubalus
21. Adlumia fungosa
22. Cakile edentula
23. Sisymbrium officinale var. leiocarpum
24. Tiarella cordifolia
25. Hamamelis virginiana
26. Geum urbanum
27. Prunus serotina
28. Trifolium repens
29. Lathyrus japonicus var. glaber
30. Oxalis montana
31. O. corniculata
32. Acalypha virginica
33. Euphorbia polygonifolia
34. Acer pensylvanicum
35. A. rubrum
36. A. spicatum

37. Impatiens capensis
38. Malva rotundifolia
39. Circaea alpina
40. Fraxinus americana
41. F. nigra
42. Lamium amplexicaule
43. Lycopus americanus
44. Campsis radicans
45. Plantago rugelii
46. Galium triflorum
47. Solidago sempervirens
48. Ambrosia artemesiifolia var. elatior
49. Bidens connata var. gracilipes
50. B. frondosa
51. Arctium tomentosum
52. Taraxacum officinale

THE BULBIFEROUS RANUNCULUS FICARIA. — Recent examination of this European species in two localities in the Boston area has shown that in both cases it is represented only by the bulbiferous variety, *Ranunculus ficaria* L. var. *bulbifera* Marsden-Jones. Cytotaxonomic studies carried out in Britain have shown that *Ranunculus ficaria* exists in at least two cytodemes, the diploid *R. ficaria* var. *ficaria* (*R. ficaria* var. *fertilis* Clapham) ($2n = 16$) and the tetraploid *R. ficaria* var. *bulbifera* ($2n = 32$). They are separable on a number of minor morphological and ecological features (see Marsden-Jones in Jour. Linn. Soc. Lond. Bot. **50**: 39. 1935 or D. E. Allen in Proc. Bot. Soc. Brit. Is. **3**: 45. 1958, or even van Tieghem in Ann. Sci. Nat. sér. 5, 5:88. 1866 who was naturally unaware of the cytological significance of his observations.) but most significant and noticeable of all is the fact that the tetraploid bears bulbils in the leaf axils and has a very reduced seed fertility whereas the diploid is quite fertile and does not produce bulbils. These bulbils do not become apparent until after the plant has been in flower for a few days when they rapidly enlarge to about the size of a grain of wheat.

The two populations examined this spring, one in the garden of 383 South Street, Jamaica Plain and the other in the Case Estates at Weston, both show the production of abundant bulbils. Cytological examination of both populations was made using acetocarmine squashes of the developing bulbils. This proved to be very favorable material, particularly during early stages of development, at which time a mass of cells near the apex of the bulbil is dividing quite

rapidly. The chromosomes are rather long, however, and better preparations were obtained when the material was pre-treated for three hours in colchicine to shorten the chromosomes, fixed in Carnoy's solution, and softened for 10-15 minutes in 10% HCl.

In both populations examined the bulbils were found to be composed primarily of tetraploid cells ($2n = 32$). However, occasional triploid cells were observed in several bulbils from both populations. A few cells seemed to have a chromosome number intermediate between triploid and tetraploid, but in all cells that could be counted with certainty the somatic number was either 24 or 32. Possibly the cytological situation here is comparable to that observed in tissue cultures in which there is considerable variation in chromosome number. (See Torrey, J. G. in 7th Symposium of Society for the Study of Development and Growth, 189-222. 1959.)

Examination of the pollen revealed that less than 20% of the grains were either abortive or failed to stain normally. The remaining grains stained densely with acetocarmine and appeared normal, except for the fact that the size variation was rather high. It seems unlikely that the plants could be triploid and produce pollen that is over 80% fertile. Triploids have been reported in *Ranunculus ficaria* from areas in which the diploid and tetraploid varieties overlap, but these triploids are characterized by a high percentage of abortive pollen (Neves in Bol. Soc. Brot. ser. 2, **16**: 169. 1942, see also 46th (1955), Ann. Rept. John Innes Hort. Inst. 20-21. 1956). The plants in the above populations produced no fertile achenes this spring, but in view of the reasonably high pollen fertility observed it is possible that these plants are outbreeders and appear sterile due to the lack of pollen from a different individual. The populations examined were small and probably consist of a single vegetative clone. It is hoped that cross pollinations and a study of meiotic material next spring will clarify this point.

The specimens of *Ranunculus ficaria* in the Gray Herbarium and the New England Botanical Club Herbarium were next examined and it is significant that whereas several spec-

imens show distinct axillary bulbils, none of the others may be identified with certainty as var. *ficaria*. Those where bulbils were not apparent were all collected early in the flowering season before the end of April when the bulbils would not be seen even on var. *bulbifera*. Every one of the specimens gathered after the beginning of May shows the presence of bulbils.

The examination of other herbaria would no doubt reveal other records and a tour of New England reveal other populations, but the main object of this note is to draw the attention of botanists in N. E. America to the existence of this polyploid and bulbiferous variety. It would also be most interesting to know whether it is only this variety that has been introduced from Europe.

The following are the herbarium records we have seen of var. *bulbifera*. CANADA. QUEBEC: comté de Jacques-Cartier, ville-Lasalle, dans les bruissons le long d'une clôture, 23 May, 1932. *Marie-Victorin & Rolland-Germain 46, 833* (GH). UNITED STATES. MASSACHUSETTS: Middlesex Co., Cambridge, spreading in William Brewster's garden, 8 May 1914, *Walter Deane* (NEBC); Norfolk Co., Milton, wild weed of my garden, 23 June 1923, *N. T. Kidder* (NEBC); Plymouth Co., South Hingham, May 1891, *H. W. Cushing* (GH) and moist soil in garden, transplanted from original locale, 10 May 1947, *C. H. Knowlton* (NEBC); Worcester Co., Lancaster, wild garden of Mrs. N. Thayer, never seen there before, June 1924, *Mrs. J. E. Thayer* (NEBC). PENNSYLVANIA: Philadelphia, "Nurseries", Fairmont Park, 7 May 1910, *H. St. John 111* (GH). (Herbarium specimens of plants that were examined cytologically in this investigation have been deposited in the Gray Herbarium). — PETER S. GREEN AND JOAB L. THOMAS, ARNOLD ARBORETUM, HARVARD UNIVERSITY.

A USEFUL MULTILINGUAL BOTANICAL DICTIONARY.[1] — In recent years more and more scientists in the New World have taken up the study of Russian in order to benefit more directly from the flood of Russian scientific books and papers now available to them through various channels. For most of them this pays, instead of waiting an inordinately long

[1]N.N. Davidov and F. Kh. Bakhteyeva, 1960: Botanical Dictionary, Russian-English-German-French-Latin. — Glavnaya Redaktsiya Inostrannykh Nauchno-Teknicheskikh Slovarey Fizmatgiza, Leninsky Prospekt 15, Moskow V-71. 1 ruble 16 kop.

time for an official translation, the appearance of a reference journal where the desired information may be found, or such. But with only a slight knowledge of Russian and perhaps a not too good dictionary at hand, it can at times be quite hard to get the exact meaning of terms. However, at least for botanists, this dilemma is now solved with the appearance of a multilingual botanical dictionary, compiled by N. N. Davidov and edited by F. Kh. Bakhteyev.

The book is actually a list of botanical terms and plant names directly translated from Russian into English, German and French as well as Latin, and permits quick translation to or from any of these five languages. Thus it is actually of a much wider use than for those reading Russian texts only, and is a help also for English-speaking botanists reading French, German or even Latin works. According to the foreword, it is the first time that such a botanical dictionary has been published in Russia, and the authors are to be congratulated on their achievement.

The dictionary contains about 6000 botanical terms of which some 30% refer to plant names only. The choice of vernacular names in English, French and German has certainly been a difficult task, and some rarely used names are met with here and there. But as the Latin names — in some cases the specific name, in others only the generic name, but always the family name — are included also, no real difficulty of identification of the common name is met with. Names of wild plants are of course referable mostly to Russian species, but common names for a goodly number of cultivated plants from the world over are also included.

Regarding the about 4000 proper terms themselves, it is pleasant to note that they cover the botanical field very widely and seem to reach out into neighboring fields such as cytology and genetics as well.

It is quite evident, however, that the authors have done their utmost to make the book compact, and to give for each Russian word, if possible, only a single-word expression in the other languages. This has resulted in the choice of a number of the English terms seemingly rather unfamiliar to

the young botanists who do not have the knowledge of Latin and Greek, which was so useful to their older colleagues. Such words as grumous, hiant, irrorate, vittate and poecilophyllous, to mention a few random examples, might have been better translated with a more modern expression such as, respectively: lumpy (about roots), gaping, sprinkled with dew, with bands or stripes, with various-colored leaves. Fortunately most of these unfamiliar words are explained by a glance at the corresponding German or French expressions, or are relatively easy to find in the Oxford, Webster, or some other widely used English dictionaries. So far, I have been unable to find the English counterpart of the word "trullifolius" only, but as the Botanical Dictionary itself gives the word "trulliformis" as corresponding to "saucer-shaped", it requires only a small portion of imagination to understand that "trullifolius" means "with saucershaped leaves". This phrase would, of course, have been better to use than the old-fashioned Latin derivative. There are admittedly a number of such outmoded English expressions in the book, but not nearly enough to cause concern, and as demonstrated, usually possible to get at by some round-about way.

In rapidly reading through all the English terms listed in the English index, I came across a few unfortunate misspellings (e.g. s*k*iophyte for sciophyte, diclin*y* instead of diclin*ism*, induvi*a* for induv*ium*) which have eluded the authors themselves, who found about 25 words from all the languages requiring correction on an inset leaf at the end of the book. In comparison to the total number of words in the book, these misprints are indeed very few and in no case really serious or misleading.

The few negative remarks above should not be allowed to obscure the more excellent properties of the book. A very good feature is the accentuation of the Russian words and the indication of the gender of all nouns in Russian as well as in German and French, even when these words are preceded by adjectives. This is actually more information than is given in some current and in other respects excellent Rus-

sian dictionaries, and a feature that will be very helpful to students using this book.

The unusual arrangement of numbering each Russian word in the actual dictionary part of the book, and using these numbers in the clear and easily read English, German, French and Latin indices for a quick reference to the location of the particular word in the dictionary is highly laudable. It is particularly this feature that makes the use of the book so universal and not only restricted to those who want to read a Russian text or translate into Russian. Now anybody, say English-speaking, who wants to read e.g. a French, German or even Latin text, can use this handbook to full advantage, even if he is completely ignorant of any Russian, its letters or order of alphabet. The following line may serve as an example of the system:

453 BÉTKA f || bough, branch, limb || Ast m, Zweig m || branche f || ramus.

The Botanical Dictionary is clothbound, of a handy, compact size, well printed and very easy to read. It is thus a pleasure to recommend this excellent book to all colleagues in the wide field of Botany and not only to those directly interested in Russian botanical literature. It could be said about it that it is truly an aid to international understanding. — DORIS LÖVE, INSTITUT BOTANIQUE, UNIVERSITÉ DE MONTRÉAL, CANADA.

A NOTABLE ASSEMBLAGE OF PLANTS IN NEW HAMPSHIRE. — This note concerns an area of hardwood forest several of whose plentiful species of ground-flora suggest conditions unusually rich for east-central New Hampshire.

The area — rather stony and originally alluvial, though most of it may be inundated only once in a decade or two — lies in the extreme northeast corner of Sandwich in Carroll County, N. H. It is reached from Route 113A at Wonalancet in Tamworth by crossing Wonalancet River at the bridge by the post office and then proceeding 0.7 miles up a gravelled public road to Squirrel Bridge (over the same river) 30 feet down a private road.

The plot of chief interest starts on the north edge of the private road — a narrow, wooded, dirt one — by a telephone pole about 70 feet south and west of the bridge and extends westerly along the road 100 feet. In width, it extends northerly toward the river a mere ten feet; beyond that width, the dense herbaceous cover thins out greatly and the more unusual species disappear.

The most unexpected plant is *Asarum canadense* L. This and *Viola pensylvanica* Michx. *var. leiocarpa* (Fern. & Wieg.) Fern. are perhaps the two most abundant herbs. They occur little if any beyond the ten foot line back from the road, and elsewhere in the general area and within 100 feet of the river they seem to be found only along the edge of the same road and of smaller wood roads and paths.

Two other rich-woods plants in the plot are *Botrychium virginianum* (L.) Sw. and *Dicentra Cucullaria* (L.) Bernh. Other more commonplace herbs readily identifiable in June include, more or less in decreasing order of abundance there, *Uvularia sessilifolia* L., *Viola rotundifolia* Michx., *Dryopteris Phegopteris* (L.) Christens., *Arisaema atrorubens* (Ait.) Blume, *Smilacina racemosa* (L.) Desf., *Polygonatum pubescens* (Willd.) Pursh, *Trillium erectum* L., *Streptopus roseus* Michx. *var. perspectus* Fassett, and the two species of *Actea* L.

The two commonest shrubs on the plot are *Acer spicatum* Lam. and *Prunus virginiana* L. The two commonest trees are *Acer saccharum* Marsh. and *Fraxinus americana* L. *Juglans cinerea* L. and *Tilia americana* L. overhang parts of the plot.

Additional plants of interest occurring nearby along the river or within 100 yards downstream and somewhat unusual for the region are *Sanguinaria canadensis* L., *Viola Selkirkii* Pursh, and *V. renifolia* Gray.

Frederic L. Steele assisted me with identifications in the field.

The plot on which the above plants are growing, as well as adjoining land, is threatened with development for house lots. — ALEXANDER LINCOLN, JR., MEREDITH, NEW HAMPSHIRE.

THE SPECIFIC EPITHET OF THE PECAN. — According to Article 73 of the International Code of Botanical Nomenclature (Regnum Vegetabile **8**: 46. 1956), "The original spelling of a name or epithet must be retained, except that typographic or orthographic errors should be corrected." Fernald (Rhodora **49**: 194-196. 1947) showed that *Juglans illinoinensis of* Wangenheim (Beytr. z. teutsch. holzg. Forstwiss. Nordam. Holz. 54. 1787) is the earliest valid name for the pecan. Koch (Dendrologie 1: 593. 1869) transferred *Juglans illinoinensis* to *Carya*, but altered the spelling of the specific epithet to *illinoënsis*. Koch's version of the epithet (with or without the diaeresis) is the one now universally used — in violation of Article 73 — in North American botany. Rehder (Journ. Arn. Arb. **22**: 572. 1941) expressed the opinion that the spelling *illinoinensis* used by Wangenheim is possibly "a typographical error or . . . a slip of the pen." Such would not seem to be the case because *illinoinensis* occurs at least twice in Wangenheim's work: in the description of the "Illinois Wallnut Tree" on page 54, and in the running head on page 55. *Illinoinensis* was surely intentionally spelled so. Admittedly, Wangenheim's spelling is perhaps not the best for a Latin adjective derived from a French word. "Illinoisensis" or even "illinoensis" may be preferred, although there would appear to be no hard and fast rule for the Latinization of a word such as Illinois. All this is beside the point, however. The fact remains that Wangenheim used *illinoinensis* and that this spelling must, according to the Code, be retained. The scientific name of the pecan is *Carya illinoinensis*, not *C. illinoensis*. — JOHN W. THIERET, CHICAGO NATURAL HISTORY MUSEUM.

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